Web Application Architecture Modeling Using UWE & WebML

A Synopsis

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INTRODUCTION

Due to increasing complexities of web applications there is a need of designing their architecture. Therefore the recent efforts have been made to develop the separate modeling of the conceptual, navigational and presentation aspects of the web applications. The web applications are different from the web sites in the sense that the web applications execute business logic not on the presentation. Therefore the information architecture of web applications plays an important role in designing the web applications. The web architecture can be defined as the structuring a web site to achieve the business goals. It is an approach to design and planning of websites which involve technical, aesthetic and functional criteria [1]. The basic web architecture is a two tier architecture consisting of two main components namely the web client that displays information content and the web server that transfers information to the client.

Modeling is an activity for understanding the system. Modeling is a proven and well accepted technique in designing the engineering systems. A model properly chosen can enable the modeler to work at higher levels of abstraction [2].

Through modeling we achieve four aims [3]:

1. Modeling helps us to visualize a system as it is or as we want it to be.

2. Modeling permits us to specify the structure or behavior of a system.

3. Modeling gives us a template that guides us in constructing a system.

4. Modeling documents the decisions we have made.

There are many modeling techniques for modeling the systems according to the application areas. The Unified Modeling Language (UML) is a general purpose modeling language mainly developed for the Object-oriented systems but can be applied in

modeling other non-software systems. Through its extension mechanism, it can be customized in domain specific modeling. Therefore in this work we will explore how UML based techniques (i.e. UWE) are used in modeling the web architecture. The World Wide Web Consortium has developed a specific modeling language, i.e.WebML for modeling the web architecture [4]. In this research work, the modeling of the web architecture will be done by both the UWE and WebML by applying them in real case study. A comparison of these modeling techniques will be done based on certain parameters.

Background

Unified Modeling Language

The Unified Modeling Language (UML) is a general purpose visual modeling language used to specify, visualize, modify, construct and document the artifacts(software development) of a software system [5]. UML is widely accepted by industry as well as academia for developing software system [6].

UML History

UML was developed to simplify the large number of object oriented development methods.Before UML,there were many object oriented modeling but many users of these methods had trouble finding a modeling language that met their needs completely[7].In 1990's, Booch, Jacobson's OOSE(Object Oriented Software Engineering)and Rambaugh's OMT(Object Modeling Technique) were there. Each one had its strengths and weaknesses. In 1994,Rambaugh joined Booch at Rational Software Corporation. They combined the concepts from the OMT and Booch methods and gave first proposal of UML in 1995.Jacobson also joined Rational and began working with Booch and Rumbagh. Their joint work was called Unified Modeling Langauge(UML).1n 1996 they joined Object Management Group(OMG) and worked for them.UML was adopted unanimously by the membership of the OMG as a standard in November 1997. OMG requested proposals to upgrade UML to fix the problems faced by UML. In 2003, the major revision of UML version 2.0 was proposed and finally accepted by OMG in 2005 [8].

Advantages of UML

UML has a number of advantages [9]:

1. UML has a good structure and clear rules.

2. With UML one can adjust it to almost any kind of system.

3. It's a formal language [10].

4. It's concise.

5. It's comprehensive.

6. It's scalable.

7. It's the Standard.

UML based web architecture Techniques

UML plays a very important role in modeling web architecture. After the acceptance of the UML by the OMG as an official object modeling language, more systems are being expressed with UML notations [11]. UML has the ability to express the execution of the system's business logic in web specific elements and technologies. To support of domain specific modeling, a formal extension mechanism was defined using stereotypes, tagged values and constraints to model elements.

Web Application Extension (WAE)

Web application Extension (WAE), could be used with use-case driven software development process [12]. WAE employs UML,but it uses UML only as the notations. The extension gives the model not much object-oriented semantic since it sees the model from Web element perspective. WAE covers both server- and client-side of Web

application architecture. The server-side elements (e.g. Server Page) and the client-side notations (e.g. ActiveX, Java Applet, Java Script code etc.) have been described by using the stereotype concept of UML. However, the object oriented concepts (e.g. inheritance) are not concerned enough by the extension. A class notation in classdiagram is used for representation an HTML page.

UML based Web Engineering (UWE)

UWE is UML complaint. UWE defines a systematic development process that can be performed semi-automatically. The tool support is guaranteed by the open UWE model development environment. It comprises at the current implementation state two CASE tools: ArgoUWE to aid the design and UWEXML to generate web applications [13].

UWE uses standards including the Model Driven Development(MDD). MDD is based on models like other software development approaches but introduces a higher level of abstraction by defining metamodels and model transformation rules. The best known MDD realization is the Model Driven Architecture (MDA) of the Object Management Group (OMG). The development process of UWE is based on MDA as well as other OMG standards, i.e. the unified modeling language (UML), XML Metadata Interchange (XMI). Meta Object Facility(MOF), Object Constraint Language(OCL) and the forthcoming standard transformation language QVT [14].

UWE Approach

The UWE approach comprises a UML profile for modeling web systems, a process and tool support for the development web systems. The UWE process is a model driven development process following the MDA (Model Driven Architecture) principles using the OMG standards. It consists of set of models and model transformations, which specification is supported by metamodels and model transformation languages. UWE models are represented by UML diagrams. For modeling specific features of the Web domain, such as navigation nodes and Web pages, UWE provides a domain specific UML profile, which is defined using the extension mechanisms provided by the UML: stereotypes and OCL constraints [14].

The modeling process proposed by UWE is composed by four steps [15]:

• Requirement Analysis with Use Cases

• Conceptual Design

• Navigation Design

• Presentation Design

Requirement Analysis with Use Cases- It produces use case models that does not present by any extension for modeling elements in conventional UML.

Conceptual Design- It provides conceptual model of the application domain using UML without any new stereotype.

Navigation Design- It produces navigation space model and the navigation structure model.

Presentation Design-It produces the *static presentation model* and the *dynamic presentation model.*

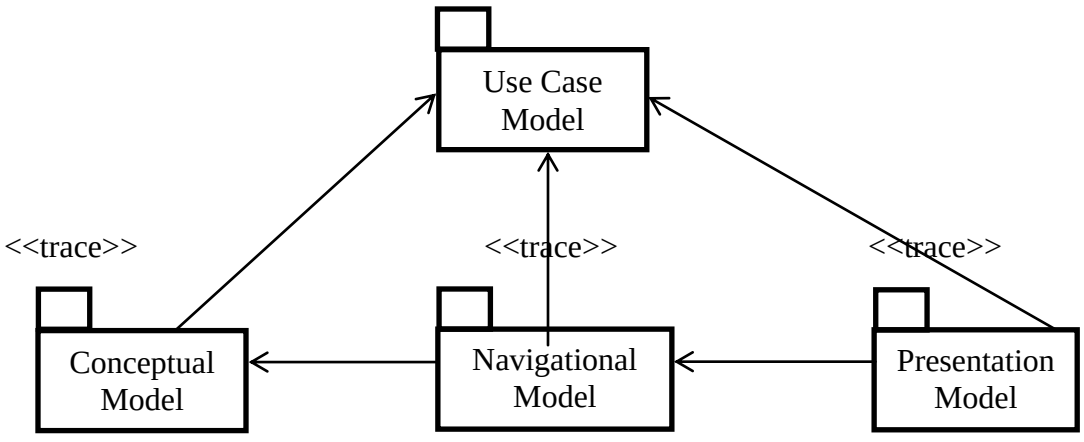

Figure 1. Models built during the Authoring Process of the UML-base Web Engineering Approach [18]

Characteristics of UWE Process [16]

1. The main characteristic of the UWE process is the systematic, semi- automatic, model driven and transformation based support of the development of web systems.

2. UWE provides tool support for the design of models, model consistency checks, and semi-automatic generation of Web systems. ArgoUWE (ArgoUML) and MagicUWE (MagicDraw) are tools which support the notation of the UWE profile and transformations to assist the designer's work.

WebML (**Web Modeling Language**)

To meet the maintenance problems in web applications development W313 project (Fundedby the European Community under the Fourth Framework Program) has produced a novel Web modeling language, called WebML [17]. WebML is a visual notation for designing complex data-intensive Web applications. It provides graphical, yet formal, specifications, embodied in a complete design process, which can be assisted by visual design tools, like WebRatio.

This method has five models: structure, derivation, composition, navigation and presentation. These models are developed in an iterative process.

The specification of a site in WebML consists of four orthogonal perspectives [18]:

1. **Structural Model:** It expresses the data content of the site, in terms of the relevant entities and relationships. WebML does not propose yet another language for data modeling, but is compatible with classical notations like the E/R model, the ODMG Object-Oriented Model and UML class diagrams.

2. **Hypertext Model:** It describes one or more hypertexts that can be published in the site. Each different hypertext defines a so-called site view. Site view descriptions in turn consist of two sub-models.

- **Composition Model:** It specifies which pages compose the hypertext and which content units make up a page.

The composition model consists of a set of pages; each page has one or a set of content units, which make up the page. There are six types of data units [19]:

a. Data units

b. Index units

c. Multi-data units

d. Filter units

e. Scroller units

f. Direct units

Figure 2: Graphical representation of WebML units [19]

- **Navigation Model:** It expresses how pages and content units are linked to form the hypertext. Links are either non-contextual, when they connect semantically independent pages (e.g., the page of an artist to the home page of the site), or contextual, when the content of the destination unit of the link depends on the content of the source unit.

3. **Presentation Model:** It expresses the layout and graphic appearance of pages, independently. It presents presentation specifications also. Presentation specifications are either page-specific or generic.

4. **Personalization Model:** Users and user groups are explicitly modeled in the structure schema in the form of predefined entities called User and Group. The features of these entities can be used for storing group-specific or individual content, like shopping suggestions, list of favorites, and resources for graphic customization.

Advantages of WebML [19]

1. It is easy to understand and easy to implement.

2. It provides hypertext model which describes how the web application is Structured and designed better than any model that UML provides.

3. It consists of four models and UML has numerous amounts of models.

4. It is developed specifically for modeling web applications; UML is applicable in wider range of applications.

5. It has support for both modeling web application designs and html forms.

OBJECTIVES

The main objective of this research is to study the Web Application Architecture Modeling based on UWE and WebML. The purpose of the research will be to make web developers aware about the new modeling language WebML and UML profile UWE. It will also help web developers an insight in documenting and designing a system before building the solution.

The following objectives will be achieved:

- Comprehensive understanding of Web Architecture and its modeling techniques.
- Enhancing the knowledge about model driven approach of Web Architecture.
- Suggesting improvements in Web Architecture modeling.
- The research work will assists the web designers to efficiently model the complex web Applications.
- Comparison of both the techniques and showing the results based on their applicability.

REVIEW OF LITERATURE

Thompson Craig and Hansen Gil [1] have given the idea about the basic web architecture. They explained that the basic web architecture is a two tier architecture consisting of two main components namely the web client that displays information content and the web server that transfers information to the client. Lu Ming Karen, Ab Hamid Hafizah Siti [4, 18] have presented the Conceptual Design of Web Based Appointment Management System using Object WebML. Web Modeling Language (WebML) which specifies the web application and .Net four-tier architecture. Moreno Nathalie, Fraternali Piero and Vallecillo Antonio [6] have described the application of WebML. WebML, like any other Domain Specific Language, allows one to express in a precise and natural way the concepts and mechanisms of its domain of reference.

Spiridopoulos Konstantinos and Widen Erik [9] have presented the view about Modeling web applications, WebML versus UML. They did the comparison of two modeling languages WebML and UML.Conallen Jim [11] has given the views about Modeling Web Application Architectures with UML. To manage the complexity of web applications, it is necessary to model them. Unified Modeling Language (UML) is the standard language for modeling software intensive systems. Kaewkasi Chanwit and Rivepiboon Wanchai [12] have presenteda methodology to model Web applications directly from the object-oriented fashion on the top of the event-driven programming concept.

Knapp Alexander, Koch Nora, Moser Flavia and Zhang Gefei [13] have given a CASE Tool ArgoUWE to support the design phase of the UWE development process. It is implemented as a plugin module of the open source ArgoUML modeling Tool. Koch Nora [14] has given the classification of Model Transformation Techniques used in UML-based Web Engineering. They presented the technique UWE which is very useful in UML based Web Engineering.

Carvalho de Pinatti Fabiano Aparecido & Silva Anacleto Coutinho Junia [15] have presented a case study that what a small web system is modeled using UWE

methodology. UWE is a methodology, which provides a systematic approach to model web applications. Koch Nora, Kraus Andreas & Hennicker Rolf [16] have given their views about The Authoring Process of the UML- Based Web Engineering Approach Starting with a requirement analysis done by use cases technique, it focuses on the design phase. The conceptual model of the applicationis used as guideline for modeling the navigation space. Comai Sara, Fraternali Piero &*Milanodi Politecnico*[20] have presented their ideas about A semantic model for specifying data-intensive Web applicationsusing WebML.They described a semantic model for WebMLhypertexts by means of State charts. State charts provide a formal description of theclicking behavior and page data fill of WebML applications.

METHODOLOGY

This research will be based on the answers of some research questions by using questionnaires, by using a case study and by literature study. By doing a case study, I will be able to see the differences between UWE and WebML. The literature study will help to support the findings in the case study and in the results of our questionnaires. Using these three methods the following research problems will be solved:

- Modeling and Analysis of Web Architecture using WebML for e-learning system.

- Modeling and Analysis of Web Architecture using UWE for e-learning system.

On the basis of their application for e-learning systems, a comparative study of these technologies will be done. The study will be based onthese parameters:

1. Completeness

2. Usability

3. Simplicity

4. Readability

5. Tool Support

Hence in this work a web application will be designed and its complete architecture modeling will be done using the above mentioned modeling techniques.

REFERENCES

1. Craig Thompson and Gill Hansen, "Current Web Architecture, Object Services and Consulting", 1996, Retrieved from http://www.objs.com/survey/WebArch.htm.

2. Grady Booch, Rambaugh James & Jacobson Ivar, "The Unified Modeling Language User Guide", The Ultimate Tutorial to UML from original designers, Pearson Education Inc; 2007, page 26.

3. Booch Grady, Rambaugh James & Jacobson Ivar," The Unified Modeling Language User Guide", The Ultimate Tutorial to UML from original designers, Pearson Education Inc.; 2007, page 28.

4. Lu Ming Karen, Hafizah Siti, Hamid Ab, "Conceptual Design of Web-Based Appointment Management System usingObject WebML", IEEE 2007, page 355

5. Rumbaugh James, Jacobson Ivar and Booch Grady, "The Unified Modeling Langauge Reference Manual",Second Edition, 2008,page 23.

6. Moreno Nathalie, Fraternali Piero and Vallecillo Antonio, "WebML Modeling in UML", IET Journal.

7. Rambaugh James, Booch Grady & Javkobson Ivar,"The Unified modeling languageReference Manual" Second Edition, 2008, page26.

8. Rambaugh James, Booch Grady & Javkobson Ivar, "The Unified modeling language User Guide",Fifth Edition, 2007, page 18.

9. Spiridopoulos Konstantinos and Widen Erik, "Modeling web applications, WebML versus UML" Bachelor Thesis , Blekinge institute of Technology, Department of Computer Science & Software engineering.

10. http://www.eecho.info/Echo/uml/uml-six-main-advantages.

11. Conallen Jim, "Modeling Web Application Architectures with UML", Communication of the ACM, October 1999, vol. 42, Issue 10.

12. Kaewkasi Chanwit and Rivepiboon Wanchai,"WWM: A Practical Methodology for Web Application Modeling",26th international conference(COMPSAC,02)

13. Knapp Alexander, Koch Nora, Moser Flavia and Zhang Gefei, "Argo UWE: A CASE Tool for Web Applications", EMSISE 03.

14. Koch Nora, "Classification of Model Transformation Techniques used in UML-BasedWeb Engineering", International Conference on Web Engineering, 2006.

15. Carvalho de Pinatti Fabiano Aparecido & Silva Anacleto Coutinho Junia, "Extending UWE to Improve Web Navigation Project – A Case Study.

16. Koch Nora, Kraus Andreas & Hennicker Rolf, "The Authoring Process of the UML- Based Web Engineering Approach.

17. LMU – Ludwig-Maximilians-Universität München Institute for Informatics, UWE- UML based web engineering. Retrieved from http://uwe.pst.ifi.lmu.de/

18. Lu Ming Karen, Ab Hamid Hafizah Siti, "Conceptual Design of Web Based Management System using Object WebML ", IEEE: 2007, page 354.

19. http://en.wikipedia.org/wiki/WebML.

20. Comai Sara, Fraternali Piero &*Milanodi Politecnico, "*A semantic model for specifying data-intensive Web applicationsusing WebML" , Semanatic Web Semantic Web Workshop2001.